GAS DYNAMIC BEHAVIOR OF REAL GASES

BASED ON THE BEATTIE-BRIDGEMAN EQUATION OF STATE AND VARIABLE SPECIFIC HEAT FROM SPECTROSCOPIC MEASUREMENTS

BY

LIANG NENG TAO

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AN ABSTRACT OF A THESIS

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GAS DYNAMIC BEHAVIOR OF REAL GASES

In the treatment of gas dynamic problems it is often assumed that the behavior of the medium is that of a perfect gas. But this assumption may not be justified for real gases. From classical thermodynamics the perfect gas satisfies the following two definitions: (1) It obeys the Boyle-Charles equation of state, $p = \rho RT$, and (2) The specific heat or heat capacity is independent of the pressure and temperature. The Boyle-Charles equation of state may not be satisfactory for actual gases particularly at high pressure and at low temperature. The specific heat or heat capacity of a gas would not be a constant throughout a wide range of temperature and pressure.

In order to improve the accuracy in problems involving real gases the gas dynamic relations for the problems of isentropic flow, normal and oblique shocks have been derived in a generalized manner by the use of the Beattie-Bridgeman equation of state and variable specific heat relations obtained from the spectroscopic measurements so that they may be applied to any gas. The gas dynamic relations between the properties and geometrical quantities determining the flow configurations have been represented in terms of specified constants of the gaseous medium with Crocco number as independent variable. Due to the fact that the correction factors of real gases are dependent upon initial conditions it is necessary to specify the initial conditions for numerical calculations. For illustration, a series of calculations using "Freon-12" as the medium have been performed and tabulated with the Crocco number as independent variable. The comparison of the behavior of "Freon-12" and a fictitious ideal gas with $k = 1.14$ and $C_v = 14.21$ Btu/lb-mole-F has been represented graphically

VITA

Liang Neng Tao was born on June 27, 1927 in Shanghai, China. After graduating from high school in 1945, he entered the National Chiao Tung University of China and received the degree of Bachelor of Science in Mechanical Engineering from that institution in June, 1949. Since then he began his graduate work at the University of Illinois where he received the degree of Master of Science in Mechanical Engineering in June, 1950. He has held a University Fellowship in the academic year 1951-52 and a Research Assistantship in 1952-53.